

JIAN HE

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CIRES Research Scientist II

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Education

Ph.D. in Atmospheric Science, North Carolina State University, 2015

M.S. in Marine Geology, Nanjing University, 2011

B.S., in Geographical Science, Nanjing University, 2008

Research Specialties and Skills

My research specialties include global/regional air quality, methane trends and variability, atmospheric chemistry-climate interactions, gas-phase chemistry and interaction with aerosols, aerosol microphysics and thermodynamics, aerosol-cloud-precipitation-climate interactions, air-sea interactions, and data assimilation.

I have strong coding skills in both global and regional Earth system models, atmospheric models, and ocean models, including GFDL-ESM4 (AM4), CESM (CAM-Chem), WRF (including WRF-Chem, WRF-CAM5, WRF-CMAQ), and COAWST (ROMS), and program languages such as FORTRAN, NCL, C, Matlab, and Python. I also have extensive model evaluation experience using surface observations, aircraft measurements, and satellite retrievals.

Professional Experience

Research Scientist II, Cooperative Institute for Research in Environmental Sciences at the University of Colorado Boulder/NOAA Chemical Sciences Laboratory, Boulder, CO, July 2020-present

- Estimates of oil/gas emission contribution to methane
- Emission evaluation against surface in-situ measurements, field campaign observations, and satellite retrievals.
- Regional air quality model development and evaluation

Postdoctoral Research Associate, Program in Atmospheric and Oceanic Sciences (AOS), Princeton University/Geophysical Fluid Dynamics Laboratory, Princeton, NJ, November 2017-June 2020

- Quantify the contribution of individual methane sources and sinks to atmospheric methane trend and variability using NOAA GFDL's Earth System Model version 4.1 (ESM4.1).

Postdoctoral Fellow, ORISE Research Participation Program and NRC Research Associateship Program at U.S. Environmental Protection Agency, Durham, NC, November 2015-2017

- Surface data assimilation in the Weather Research and Forecasting (WRF) model;
- Impacts of convective adjustment time scale on deep convection and precipitation using WRF model;
- Quantify aerosol direct/indirect effects on large scale and subgrid-scale clouds in the two-way coupled WRF and the Community Multiscale Air Quality (CMAQ).

Visiting Graduate Student, Advanced Study Program at the National Center for Atmospheric Research, Boulder, CO, April-June, 2014

- Incorporate NCSU's version of the Community Atmosphere Model (CAM) to the latest CAM (version 5.3) within the Community Earth System Model (CESM, version 1.2.2) for potential community use;
- Implement extended Model for Ozone And Related chemical Tracers (MOZART) mechanism into CESM1.2.2/CAM5 and coupled with NCSU's version of aerosol module;
- Evaluating model performance and comparing extended MOZART with the 2005 Carbon Bond mechanism with Global Extension (CB05_GE) to investigate the impacts of different mechanisms on secondary gas and aerosol predictions (e.g., O₃, CO, NO_x, SOA, PM, etc).

Graduate Research Assistant, North Carolina State University, Raleigh, NC, August 2011-2015

- CESM/CAM5 development/improvement of chemistry and aerosol microphysics (e.g., gas-phase chemistry, heterogeneous chemistry, particle formation, and aerosol thermodynamics) to reduce the model uncertainties associated with these processes;
- Retrospective decadal applications of CESM/CAM5 and comprehensive model evaluation to investigate the model's capability to represent present atmosphere and uncertainties for future climate projection;
- Develop regional earth system model by coupling the Regional Ocean Modeling System (ROMS) with the Weather Research and Forecasting model with Chemistry (WRF/Chem) within the frame work of the Coupled-Ocean-Atmosphere-Wave-Sediment Transport Modeling System (COAWST) to study the impacts of air-sea interactions on regional air quality and climate;
- Comprehensive evaluation of WRF-CAM5 over East Asia to examine the model's capability in reproducing current regional air quality, climate, and their interactions.

Graduate Research Assistant, Nanjing University, Nanjing, China, September 2008-July 2011

- Investigate sediment dynamics in coastal systems through measuring radioisotopes from field samples.

Professional Activities

Contributor, Methane Assessment for the Climate and Clean Air Coalition, 2019-2020.

Contributing Author, Intergovernmental Panel on Climate Change Assessment Report 6 Working Group I, Chapter 5 (Global Carbon and other Biogeochemical Cycles and Feedbacks), 2018-2021.

Contributing Author, Intergovernmental Panel on Climate Change Assessment Report 6 Working Group I, Chapter 6 (Short-lived Climate Forcers), 2018-2021.

Reviewer, *Atmospheric Chemistry and Physics (Copernicus Publications for the European Geosciences Union)*, *Journal of Advances in Modeling Earth Systems (American Geophysical Union Publications)*, *Atmospheric Environment (Elsevier Publications)*, *Environmental Research (Elsevier Publications)*, *Atmospheric Pollution Research (Elsevier Publications)*, *Journal of Environmental Management (Elsevier Publications)*, *Atmosphere (Multidisciplinary Digital Publishing Institute Publications)*, *Remote Sensing (Multidisciplinary Digital Publishing Institute Publications)*.

Member, Air & Waste Management Association (2015-2016), American Geophysical Union (since 2012), American Meteorological Society (since 2012), Earth Science Women's Network (since 2019).

Publications

To-be-submitted

1. **He, J.** et al: Modeling hydroxyl radical (OH) response to meteorological forcing: Implication for methane budget estimate, to be submitted.

Peer-reviewed

1. Horowitz, L. W., Naik, V., Paulot, F., Ginoux, P. A., Dunne, J. P., Mao, J., Schnell, J., Chen, X., **He, J.**, Lin, M., Lin, P., Malyshev, S., Paynter, D., Shevliakova, E., Zhao, M.: The GFDL Global Atmospheric Chemistry-Climate Model AM4.1: Model Description and Simulation Characteristics, *J. Adv. Model. Earth Syst.*, 12, e2019MS002032, <https://doi.org/10.1029/2019MS002032>, 2020.
2. Dunne, J. P., Horowitz, L. W., Adcroft, A. J., Ginoux, P., Held, I. M., John, J. G., Krasting, J. P., Malyshev, S., Naik, V., Paulot, F., Shevliakova, E., Stock, C. A., Zadeh, N., Blanton, C., Balaji, V., Durachta, J., Dunne, K. A., Dupuis, C., Gauthier, P. P. G., Griffies, S. M., Guo, H., Hallberg, R. W., Harrison, M., **He, J.**, Hurlin, W., Menzel, R., Milly, P. C. D., McHugh, C., Nikonov, S., Paynter, D. J., Ploshay, J., Radhakrishnan, A., Rand, K., Robinson, T., Schwarzkopf, D. M., Seman, C. J., Underwood, S., Vahlenkamp, H., Winton, M., Wittenberg, A. T., Wyman, B., Zeng, Y., and Zhao, M: The GFDL Earth System Model version 4.1 (GFDL-ESM4.1): Model description and simulation characteristics, *J. Adv. Model. Earth Syst.*, 12, e2019MS002015, <https://doi.org/10.1029/2019MS002015>, 2020.
3. Glotfelty, T., Alapaty, K., **He, J.**, Hawbecker, P., Song, X. L., and Zhang, G.: Studying scale dependency of aerosol cloud interactions using scale-aware cloud formulation, *J. Atmos. Sci.*, 1–57, <https://doi.org/10.1175/JAS-D-19-0203.1>, 2020.
4. **He, J.**, Naik, V., Horowitz, L. W., Dlugokencky, E., and Thoning, K.: Investigation of the global methane budget over 1980–2017 using GFDL-AM4.1, *Atmos. Chem. Phys.*, 20, 805–827, <https://doi.org/10.5194/acp-20-805-2020>, 2020.
5. Glotfelty, T., Alapaty, K., **He, J.**, Hawbecker, P., Song, X. L., and Zhang, G.: The Weather Research and Forecasting Model with aerosol cloud interactions (WRF-ACI):

- Development, evaluation, and initial application, *Monthly Weather Review*, 1491-1511, <https://doi.org/10.1175/MWR-D-18-0267.1>, 2019.
6. **He, J.**, and Alapaty, K.: Precipitation partitioning in multiscale atmospheric simulations: Impacts of stability restoration methods, *Journal of Geophysical Research: Atmospheres*, 123, <https://doi.org/10.1029/2018JD028710>, 2018.
 7. **He, J.**, He, R., and Zhang, Y.: Impacts of air-sea interactions on regional air quality predictions using a coupled atmosphere-ocean model in southeastern U.S., *Aerosol and Air Quality Research*, 18, 1044-1067, doi: 10.4209/aaqr.2016.12.0570, 2018.
 8. Glotfelty, T., **He, J.**, and Zhang, Y.: Improving organic aerosol treatments in CESM/CAM5: Development, application, and evaluation, *J. Adv. Model. Earth Sy.*, 9, doi:10.1002/2016MS000874, 2017.
 9. Zhang, Y., Wang, K., and **He, J.**: Multi-year application of WRF-CAM5 over East Asia-Part II: Interannual variability, trend analysis, and aerosol indirect effects, *Atmospheric Environment*, 165, 222-239, <https://doi.org/10.1016/j.atmosenv.2017.06.029>, 2017.
 10. **He, J.**, Zhang, Y., Wang, K., Chen, Y., Leung, L. R., Fan, J.-W., Li, M., Zheng, B., Zhang, Q., Duan, F.-K., and He, K.-B.: Multi-year application of WRF-CAM5 over East Asia-Part I: Comprehensive evaluation and formation regimes of O₃ and PM_{2.5}, *Atmospheric Environment*, 165, 122-142, <https://doi.org/10.1016/j.atmosenv.2017.06.015>, 2017.
 11. **He, J.**, Glotfelty, T., Yahya, K., Yu, S., and Alapaty, K.: Does temperature nudging overwhelm aerosol radiative effects in regional integrated climate models?, *Atmospheric Environment*, 154, 42-52, <https://doi.org/10.1016/j.atmosenv.2017.01.040>, 2017.
 12. Yahya, K., Wang, K., Campbell, P., Chen, Y., Glotfelty, T., **He, J.**, Pirhalla, M., and Zhang, Y.: Decadal application of WRF/Chem for regional air quality and climate modeling over the U.S. under the representative concentration pathways scenarios: Part I. Model evaluation and impact of downscaling, *Atmospheric Environment*, 152, 562-583, <https://doi.org/10.1016/j.atmosenv.2016.12.029>, 2017.
 13. Glotfelty, T., **He, J.**, and Zhang, Y.: Impact of future climate policy scenarios on air quality and aerosol-cloud interactions using an advanced version of CESM/CAM5: Part I. Model evaluation for the current decadal simulations, *Atmospheric Environment*, 152, 222-239, <http://dx.doi.org/10.1016/j.atmosenv.2016.12.035>, 2017.
 14. Zhang, Y., **He, J.**, Zhu, S., and Gantt, B.: Sensitivity of simulated chemical concentrations and aerosol-meteorology interactions to aerosol treatments and biogenic organic emissions in WRF/Chem, *J. Geophys. Res. Atmos.*, 121, 6014-6048, doi:10.1002/2016JD024882, 2016.
 15. Yahya, K., Wang, K., Campbell, P., Glotfelty, T., **He, J.**, and Zhang, Y.: Decadal evaluation of regional climate, air quality, and their interactions over the continental US and their interactions using WRF/Chem version 3.6.1, *Geosci. Model Dev.*, 9, 671-695, doi:10.5194/gmd-9-671-2016, 2016.
 16. Yahya, K., **He, J.**, and Zhang, Y.: Multi-year applications of WRF/Chem over continental U.S.: Model evaluation, variation trend, and impacts of boundary conditions, *J. Geophys. Res. Atmos.*, 120, 12,748-12,777, doi:10.1002/2015JD023819, 2015.

17. **He, J.**, Zhang, Y., Tilmes, S., Emmons, L., Lamarque, J.-F., Glotfelty, T., Hodzic, A., and Vitt, F.: CESM/CAM5 improvement and application: comparison and evaluation of updated CB05_GE and MOZART-4 gas-phase mechanisms and associated impacts on global air quality and climate, *Geosci. Model Dev.*, 8, 3999-4025, doi:10.5194/gmd-8-3999-2015, 2015.
18. Zhang, Y., Zhang, X., Wang, K., **He, J.**, Leung, L. R., Fan, J.-W., and Nenes, A.: Incorporating an advanced aerosol activation parameterization into WRF-CAM5: Model evaluation and parameterization intercomparison, *J. Geophys. Res. Atmos.*, 120, 6952-6979, doi:10.1002/2014JD023051, 2015.
19. **He, J.**, Zhang, Y., Glotfelty, T., He, R., Bennartz, R., Rausch, J., and Sartelet, K.: Decadal simulation and comprehensive evaluation of CESM/CAM5.1 with advanced chemistry, aerosol microphysics, and aerosol-cloud interactions, *J. Adv. Model. Earth Sy.*, 7, 110-141, doi:10.1002/2014MS000360, 2015.
20. **He, J.** and Zhang, Y.: Improvement and further development in CESM/CAM5: gas-phase chemistry and inorganic aerosol treatments, *Atmos. Chem. Phys.*, 14, 9171-9200, doi:10.5194/acp-14-9171-2014, 2014.
21. Gantt, B., **He, J.**, Zhang, X., Zhang, Y., and Nenes, A.: Incorporation of advanced aerosol activation treatments into CESM/CAM5: model evaluation and impacts on aerosol indirect effects, *Atmos. Chem. Phys.*, 14, 7485-7497, doi:10.5194/acp-14-7485-2014, 2014.
22. Cao, L.-G., Pan, S.-M., **He, J.**, Zhang, K.-X., Xu, Y.-H., Zhao, Y.-F., Chen, Y.-Y., Xu, W., and Wu, M.-M., ¹³⁷Cs atmospheric deposition in the Liaodong Bay, *Acta Scientiae Circumstantiae*, 35(1), 80-86, 2015. (in Chinese)
23. **He, J.** and Pan, S.-M.: ¹³⁷Cs Reference inventory and its distribution in soils along the Liaodong Bay, *Journal of Soil and Water Conservation*, 25(3), 169-173, 2011. (in Chinese)
24. **He, J.**, Pan, S.-M., Sha, H.-L., and Chen, W.-Q.: The analysis on the grain size variation of bed materials at Datong hydrological station and its response to the project constructions along the Yangtze River, *Journal of Nanjing University (Natural Sciences)*, 46(3), 344-357, 2010. (in Chinese)

Invited Talks

- **He, J.**, *Investigating atmospheric methane growth using GFDL-AM4.1 constrained with observations*, NOAA ESRL Chemical Sciences Division, Boulder, CO, February 10, 2020.
- **He, J.**, *Investigation of the global methane budget over 1980-2017 using GFDL-AM4.1*, Ocean and Climate Physics Seminar, Lamont-Doherty Earth Observatory, Palisades, NY, October 25, 2019.
- **He, J.**, *The role of atmospheric chemistry and aerosol microphysics in earth system models*, Group on Atmospheric Science and Pollution Seminar, University of North Carolina at Chapel Hill, Chapel Hill, NC, August 17, 2017.

- **He, J.**, *CESM/CAM5 development and evaluation: Aerosol chemistry and dynamics, and retrospective decadal applications*, National Center for Atmospheric Research, Boulder, CO, April 4, 2014.

Conference and Workshop Presentations (first-authored only)

- **He, J.**, V. Naik, L. Horowitz, E. Dlugokencky, and K. Thoning, 2019: Evolution of the Global Methane Budget Over the 1980-2017 period Using GFDL-AM4 Model, poster presentation at 2019 Atmospheric Chemistry Gordon Research Conference, July 28-August 02, 2019, Newry, ME.
- **He, J.**, V. Naik, L. Horowitz, E. Dlugokencky, and K. Thoning, 2018: Simulating Methane Trends and Variability Over the 1980-2014 period Using GFDL-AM4 Model, poster presentation at American Geophysical Union Annual Fall Meeting, December 10-14, 2018, Washington, D.C.
- **He, J.**, V. Naik, and L. Horowitz, 2018: Investigating Methane Trends and Variability Using the GFDL-AM4 Model and NOAA GMD Observations, poster presentation at the 46th Global Monitoring Annual Conference, May 22-23, 2018, Boulder, CO.
- **He, J.**, K. Alapaty, and J. A. Herwehe, 2017: A Generalized Simple Formulation of Convective Adjustment Timescale for Cumulus Convection Parameterizations, poster presentation at the 97th AMS annual meeting, January 22-26, 2017, Seattle, WA.
- **He, J.**, K. Alapaty, T. Glotfelty, X.-L. Song, G. Zhang, S.-C. Yu, and D.-W. Kang, 2016: Studying Aerosol Indirect Effects on Grid and Subgrid Scale Clouds Using the Two-Way Coupled WRF-CMAQ, poster presentation at 15th CMAS conference, October 24-26, 2016, Chapel Hill, NC.
- **He, J.**, T. Glotfelty, K. Yahya, K. Alapaty, and S.-C. Yu, 2016: Does Temperature Nudging Overwhelm Aerosol Radiative Effects in Regional Integrated Climate Models?, oral presentation at the 17th WRF workshop, June 27-July 1, 2016, Boulder, CO.
- **He, J.**, K. Wang, Y. Chen, X. Zhang, Y. Zhang, J-W. Fan, and L. R. Leung, 2015, Multi-Year Comprehensive Evaluation of WRF-CAM5 over East Asia, poster presentation at the Air & Waste Management Association for the 108th Annual Conference & Exhibition, June 22-25, 2015, Raleigh, NC.
- **He, J.**, Y. Zhang, J.-F. Lamarque, S. Tilmes, L. Emmons, A. Hodzic, T. Glotfelty, and F. Vitt, 2015, CESM/CAM5 Improvement and Application: Comparison and Evaluation of Updated CB05_GE and MOZART-4 Gas-Phase Mechanisms and Associated Impacts on Global Air Quality and Climate, poster presentation at the 20th Annual CESM Workshop, June 16-19, 2015, Breckenridge, CO.
- **He, J.**, Y. Zhang, and R. He, 2014, Impacts of Air-Sea Interactions on Regional Air Quality Predictions: U.S. East Coast Example, oral presentation at 2014 Hydrology, Ocean, and Atmosphere Conference, December 25-28, 2014, Suzhou, China.
- **He, J.**, Y. Zhang, J.-F. Lamarque, S. Tilmes, L. Emmons, A. Hodzic, C. Knote, and T. Glotfelty, 2014, Evaluation of CESM/CAM5.2 with Advanced Representations of Gas-Phase Chemistry, Aerosol Microphysics, and Aerosol-Cloud Interactions, poster presentation at 2014 CESM Workshop, June 16-19, 2014, Breckenridge, CO.
- **He, J.**, T. Glotfelty, and Y. Zhang, 2013, Decadal Simulation and Comprehensive Evaluation of CESM/CAM5 with Advanced Chemistry, Aerosol microphysics, and

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Aerosol-Cloud Interactions, poster presentation at the 46th American Geophysical Union Annual Fall Meeting, December 9-13, 2013, San Francisco, CA.

- **He, J.** and Y. Zhang, 2013, CESM/CAM5-CB05 GE-MAM7: Ion-Mediated Nucleation and Thermodynamics Involving Nitrate and Chloride, poster presentation at 2013 CESM Workshop, June 17-20, 2013, Breckenridge, CO.
- **He, J.** and Y. Zhang, 2013, Improvement of Inorganic Aerosol Treatments in CESM/CAM5, poster presentation at 2013 AMS meeting, January 6-10, 2013, Austin, TX.

Fellowships and Honors

Postdoc Fellowship from the National Research Council Research Associateship Programs, 2016-2017

Postdoc Fellowship from the Oak Ridge Institute for Science and Education, 2015-2016

Advanced Study Program Fellowship from the National Center for Atmospheric Research, 2014